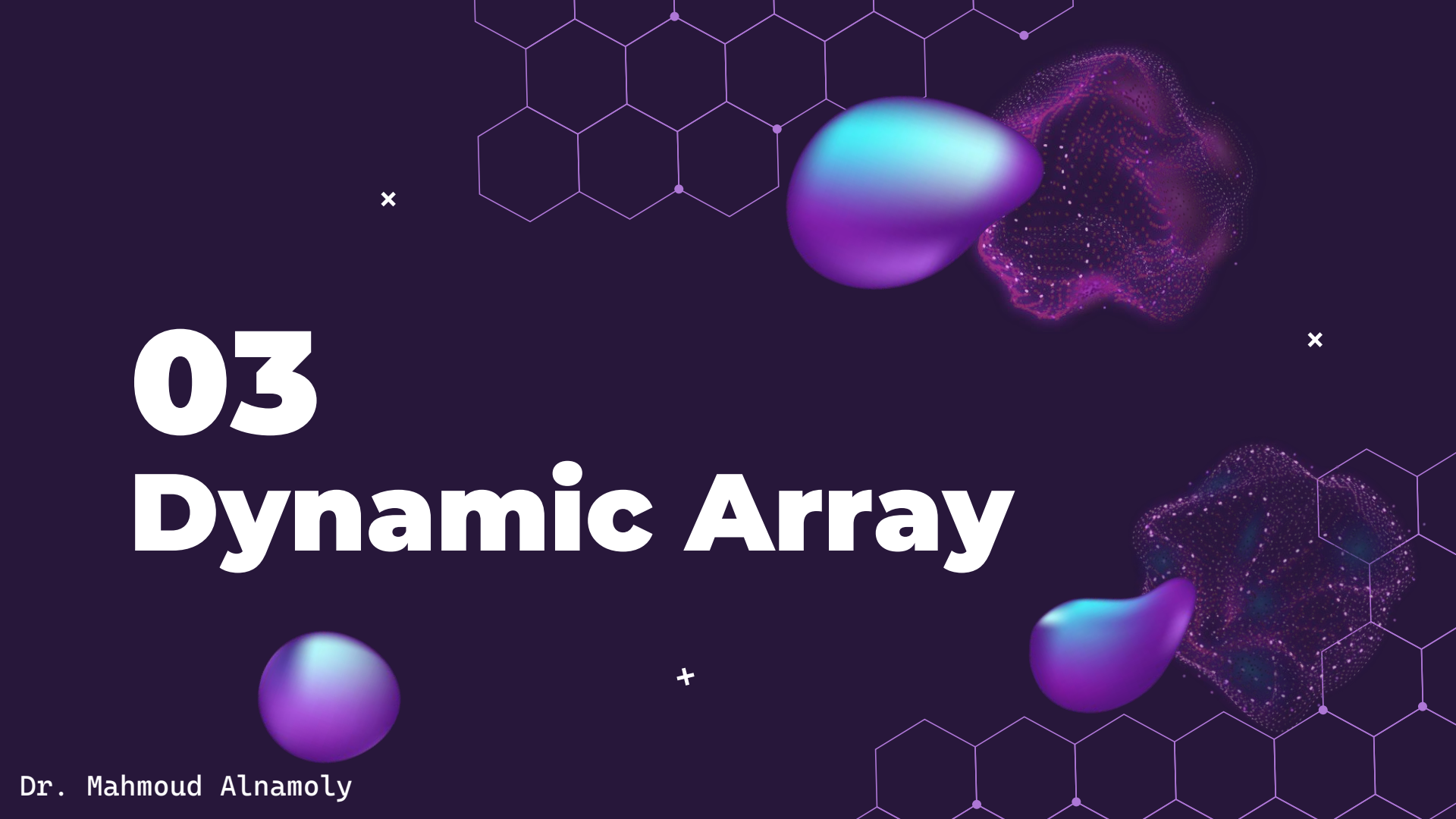
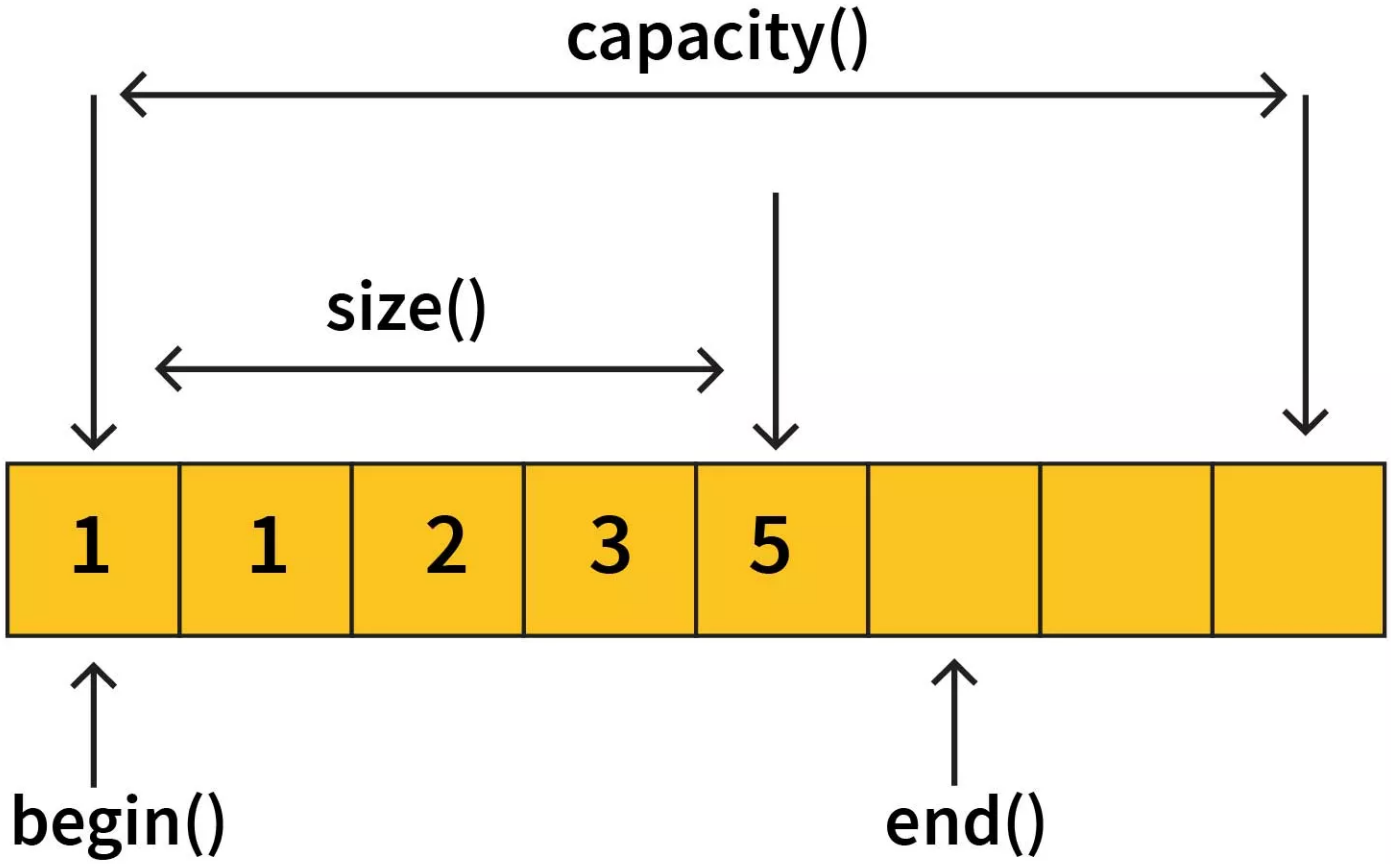

03
Dynamic Array
Dr. Mahmoud Alnamoly

```
int main(){
    const int SIZE=10000000;
    int arr[SIZE];
```

```
First-chance exception at 0x00F31B97 in Dynamic Memory Allocation.exe: 0xC00000FD: Stack overflow (parameters: 0x00000000, 0x00D02000).
Unhandled exception at 0x00F31B97 in Dynamic Memory Allocation.exe: 0xC00000FD: Stack overflow (parameters: 0x00000000, 0x00D02000).
```

```
int numofstudent;
cout << "Enter total number of students: ";
cin >> numofstudent;
int students[numofstudent];
```

Dynamic Array ?



Dynamic Array ?

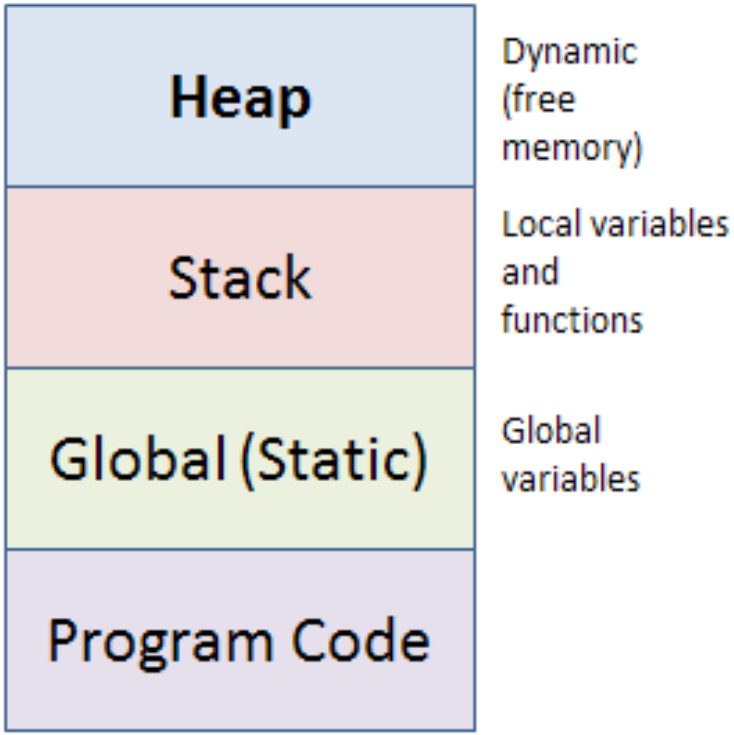
A dynamic array is quite similar to a regular array, but its size is **modifiable** during program **runtime**. Dynamic array elements **occupy a contiguous block** of memory.

Once an static array has been created, it is allocated a predetermined amount of memory and its size cannot be changed.

However, a dynamic array is different. A dynamic array can expand its size even after it has been filled as it grows its memory size by a certain factor when there is a need.

Before going on more, we need to know about Memory Allocation technique

Stack & Heap ?



STATIC MEMORY

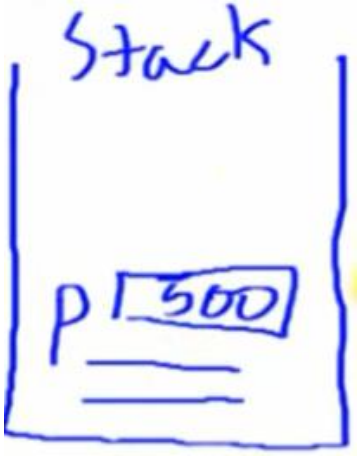
- Memory is allocated at **compilation** time
- Declaration of large memory variables (arrays) must be **determined** before the program is compiled.
  - ✓ **int students[10];**
  - ✓ What if we don't know the exact number of students in advance?

DYNAMIC MEMORY

- We can "**ask**" for memory while the program is running.
- We can **allocate** and **release** memory ourselves! "**Dynamically**"
- More powerful programming ability (also more potential for errors!)

Dr. Mahmoud Alnamoly

```
int main(){
    int *p=new int;
```



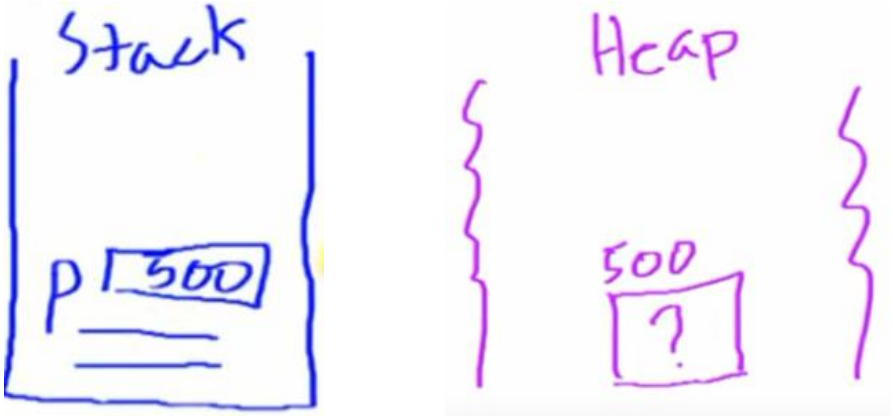
`int *p`

`new int`

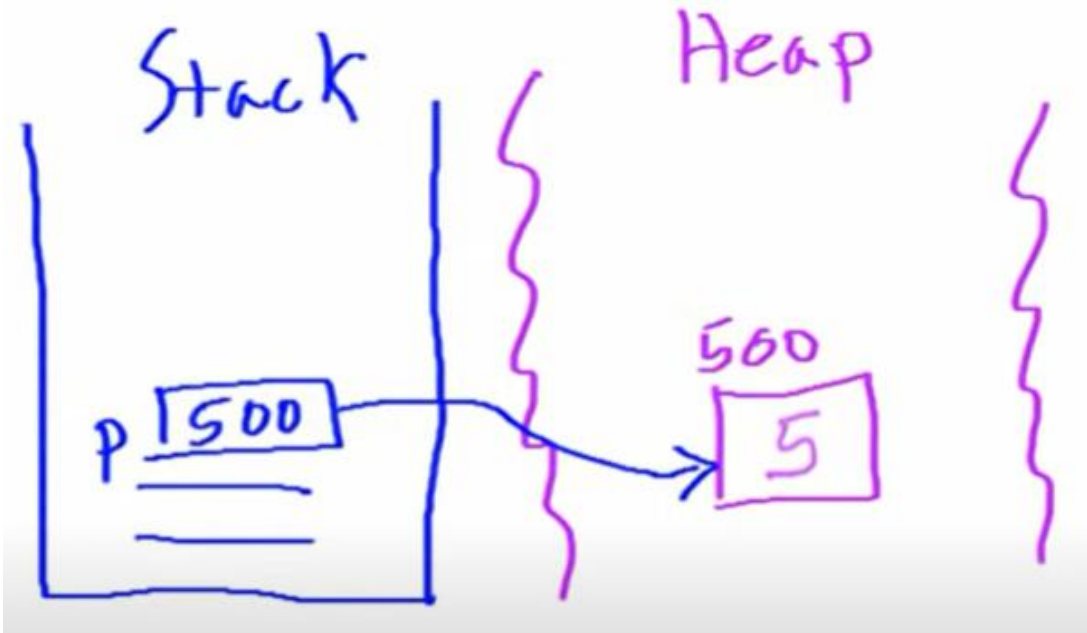
Pointer itself is stored in the stack part

Ask OS to find a segment Of memory (**“unused” memory**) of 4 btyes (for int) , then OS return the **address** of the reserved memory space

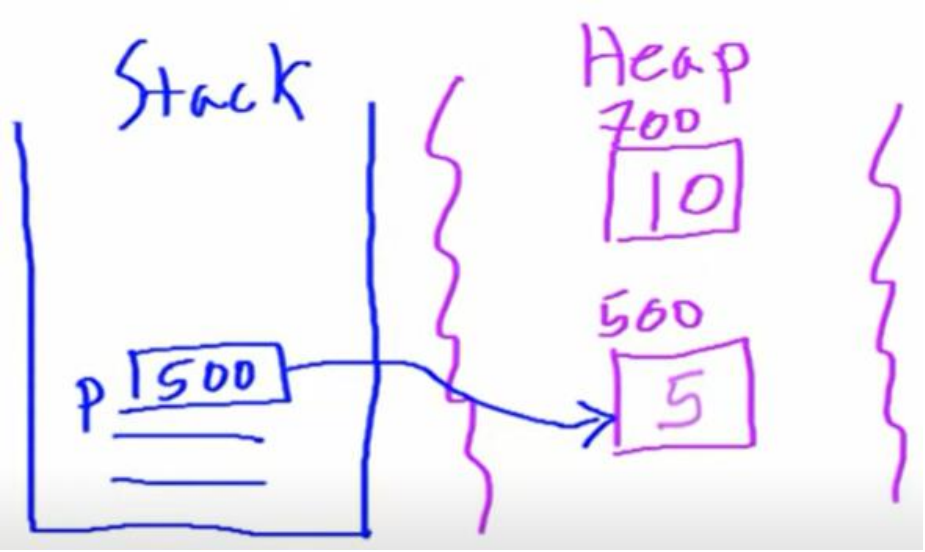
So, you need a pointer to the type you requested.
If you request <int>, you need an <int> pointer.
If you request <float>, you need a <float> pointer.

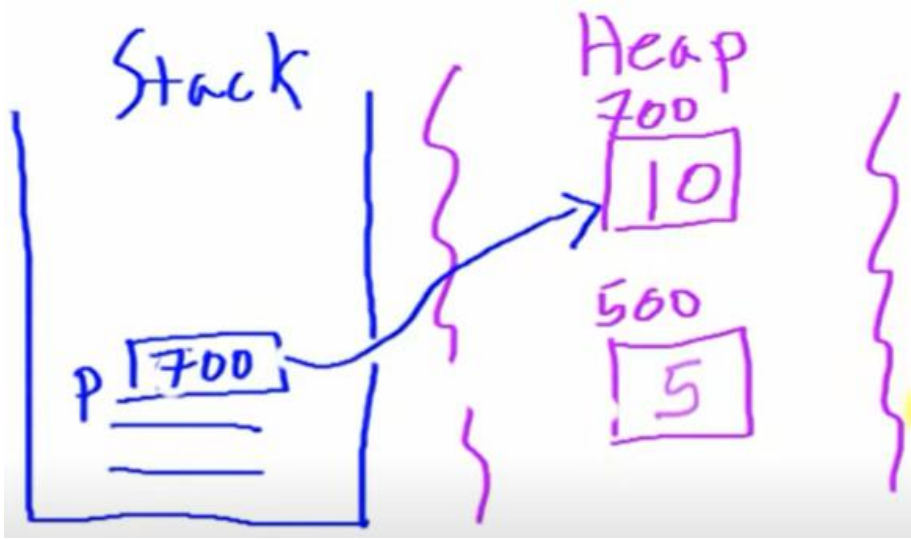



```
int *p=new int;
*p=5;
```



```
int *p=new int;
*p=5;
p=new int(10);
```



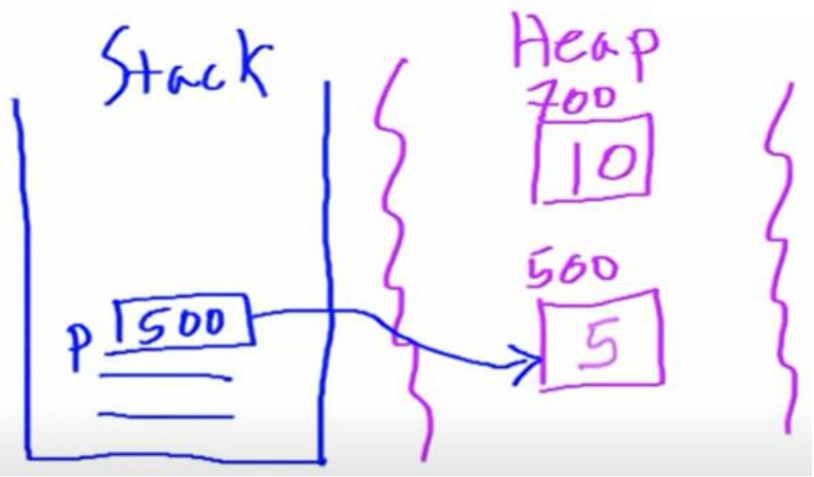


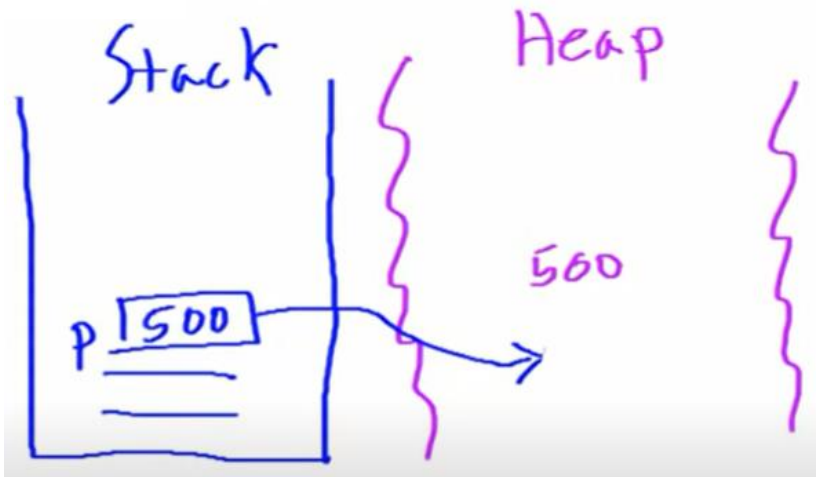
Garbage Problem

What is the main problem here ?!

- Make sure to **delete** memory when finished
- **Memory Leak Problem**

```
int *p=new int;
*p=5;
delete p;
p=new int(10);
```





delete keyword doesn't delete the pointer itself, it delete what the pointer refers to. **Delete → 5**

To delete pointer make it point to nothing NULL **p=NULL;**

How to declare a dynamic array

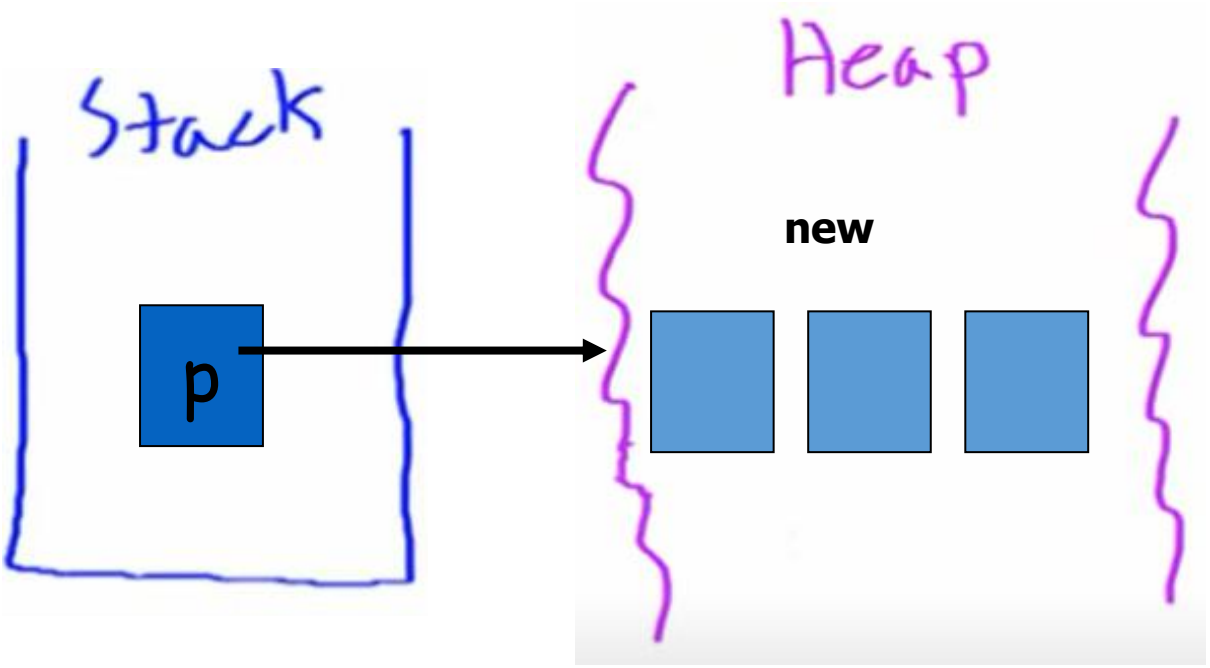
```
// uninitialized Dynamic Array
int *dynarr1=new int[500];
cout<<"dynarr1[10]= "<<dynarr1[10]<<endl;
// initialized to Zero
int *dynarr2=new int[500]();
cout<<"dynarr2[10]= "<<dynarr2[10]<<endl;
```

```
dynarr1[10]= -842150451
dynarr2[10]= 0
```

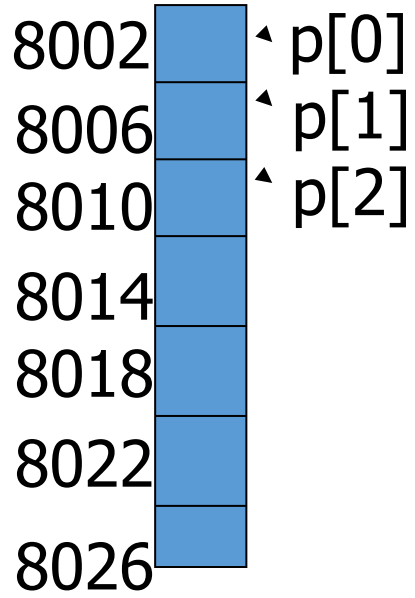
- ✓ The memory allocated for the array must be **manually released**, or else the program will have a **memory leak**.

p = new int[n];

new returns the address to the "start" of the memory it allocated




```
int *p;
p = new int[7];
//p is assigned 8002
p[0] = *(p) = *(p+0)
p[1] = *(p+1)
p[2] = *(p+2)
```

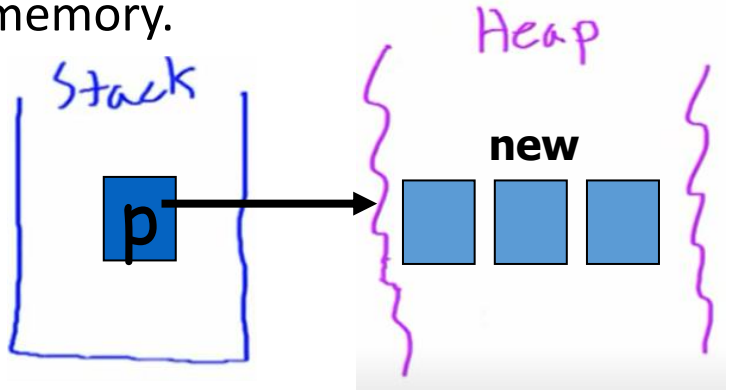


Freeing Memory from array

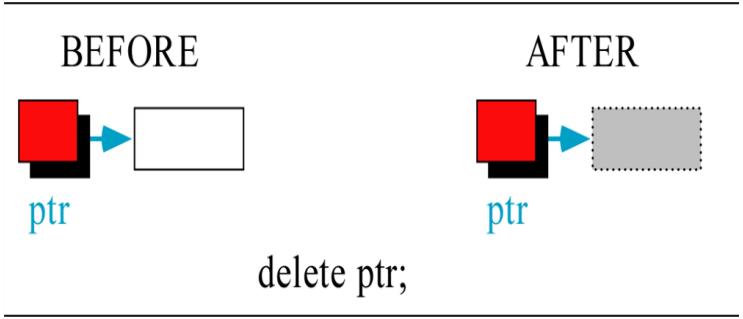
The memory you request by "new" can not be used again until you explicitly release it via "delete".

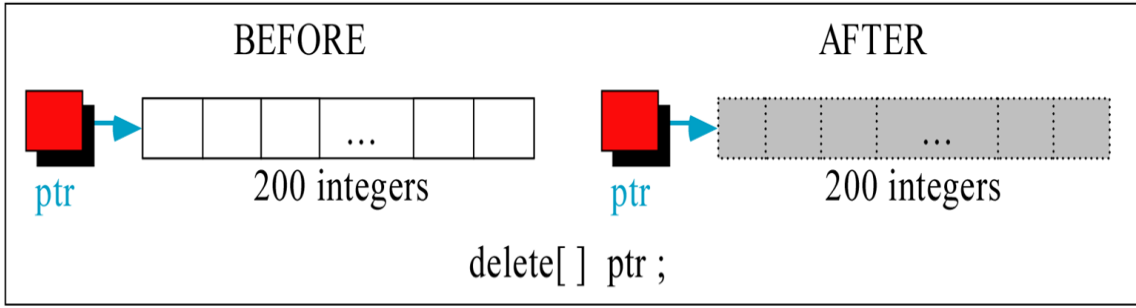
We call this "**freeing**" or "**releasing**" or "**deleting**" memory.

```
int *dynarr1=new int[500]();
delete []dynarr1;
```



The value of p will not change! However, it is now no longer points to a valid memory address.

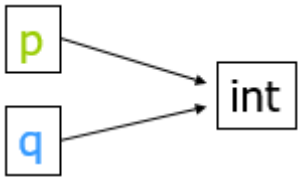


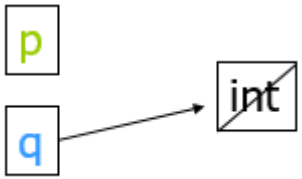


Dangling pointer problem ?

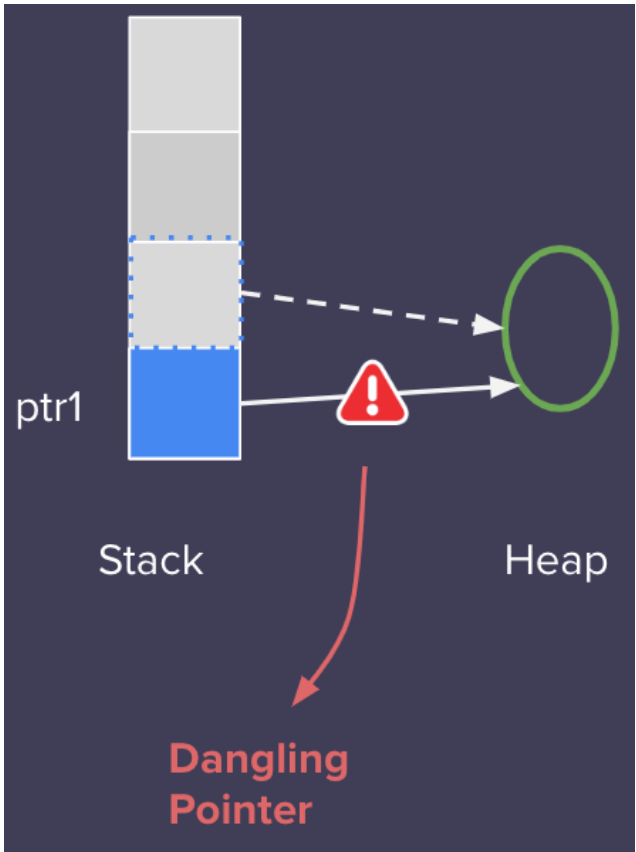
Be careful when you delete memory pointed to by p, you are not erasing a location that some other pointer q is pointing to.

```
int *p, *q;
p = new int;
q = p;
delete p;
// q is a dangling pointer
```





delete p



From SMA to DMA

```
int main(){
    const int SIZE=10000000;
    int arr[SIZE];
```

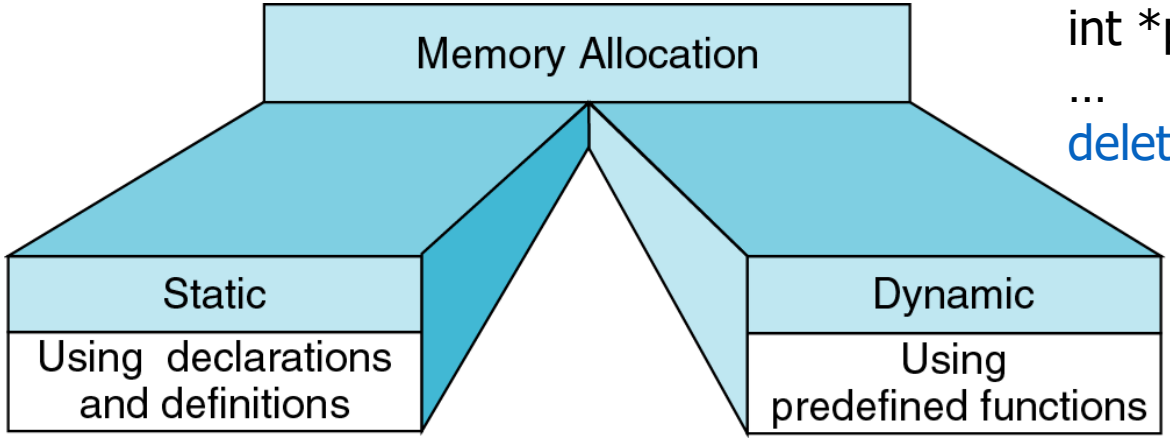
```
int main(){
    int *arrptr=new int[10000000];  //heap  //DMA
```

```
    int size;
    cin >> size;
    int *arrptr=new int[size];
```

```
int numofstudent;
cout << "Enter total number of students: ";
cin >> numofstudent;
int students[numofstudent];
```

```
int numofstudent;
cout << "Enter total number of students: ";
cin >> numofstudent;
int *students=new int[numofstudent];
```

Recap …



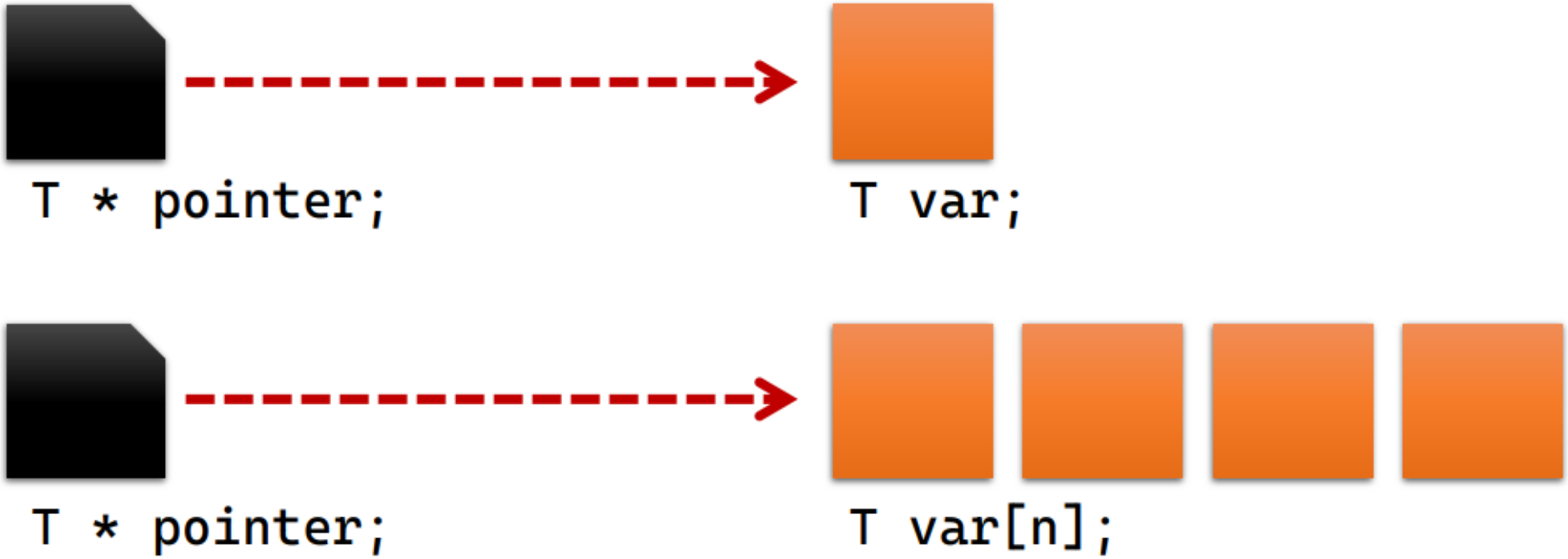

```
{
  int a[200];
  int *ptr = a;
  …
}
```

- *Memory* is acquired automatically
- *Memory* is returned automatically when object goes out of scope

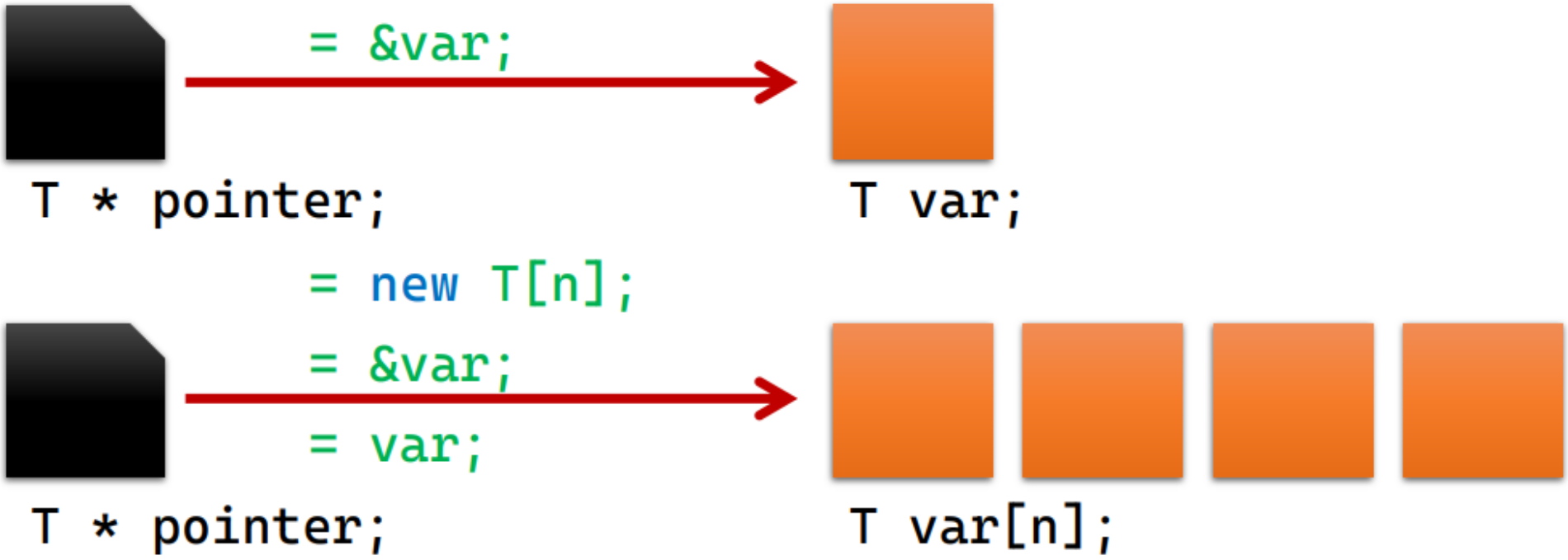
```
int *ptr = new int[200];
…
delete [] ptr;
```

- *Memory* is acquired by **program** with an allocation request
  - **new** operation
- Dynamic objects can exist beyond the function in which they were allocated
- *Object memory* is returned by a **deallocation** request
  - **delete** operation

Recap …



Recap …



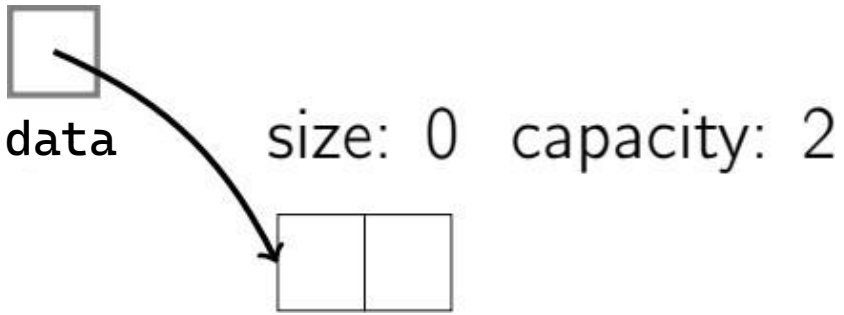
Different Dynamic Array Operations

- ✓ Add element at end.
- ✓ Insert element at a specific location.
- ✓ Remove element at index
- ✓ Find element at specific location
- ✓ Access element at index
- ✓ Clear array elements
- ✓ GetSize of array
- ✓ Display array elements

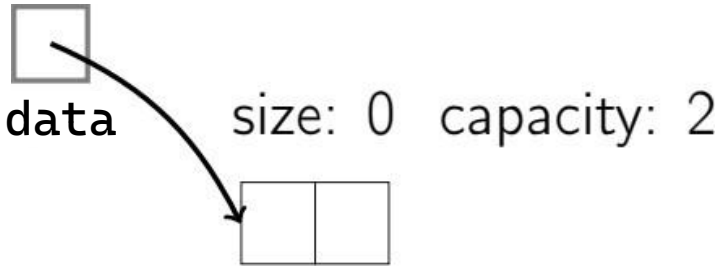
Let's explain them with code ^^
As we learned in previous lectures, all data structure will be written as a template class, then tested in main function

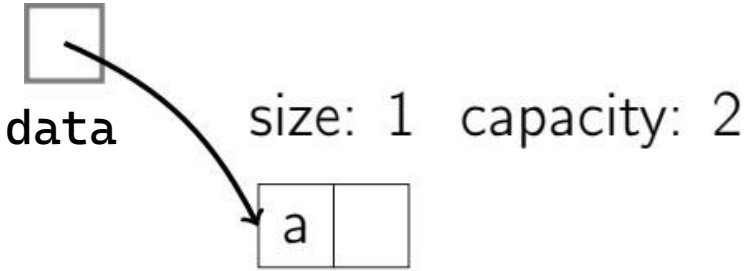
So that the first thing, we'll write a template class called DynamicArray with all needed data items, then write all these operations as a public function to be used outside Darray class

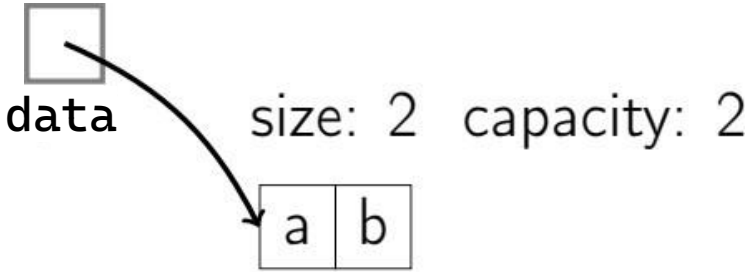
```
Template< class T>
class DynamicArray {
private:
    T* data;              // Pointer to array data
    size_t capacity;      // Maximum capacity of the array
    size_t size;          // Current size of the array


// Constructor
DynamicArray(size_t initialCapacity = 2)
    : capacity(initialCapacity), size(0) {
    data = new T[capacity]; // Allocate initial memory
}

// Destructor
~DynamicArray() {
    delete[] data; // Free allocated
}
```



✓ Add element at end

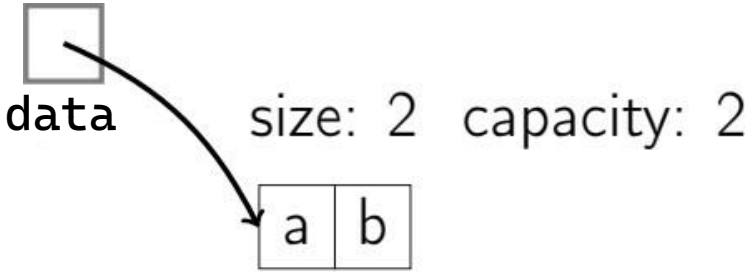




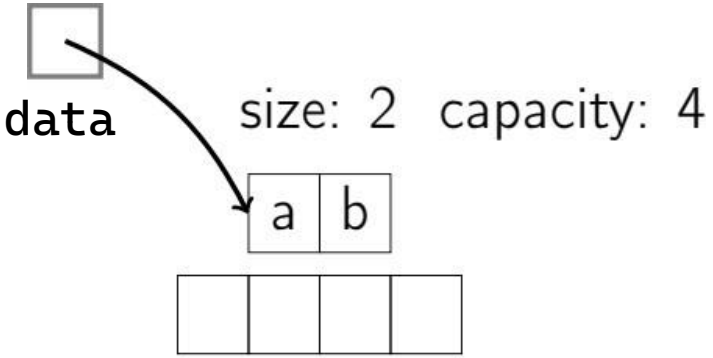



```
// Add element
void add(int element) {
    if (size >= capacity) {
        resize(capacity * 2); // Double the capacity
    }
    data[size++] = element; // Add element and increment size
}
```

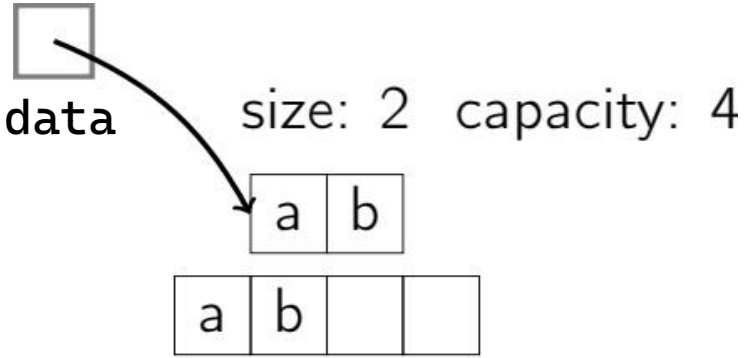
How to resize array



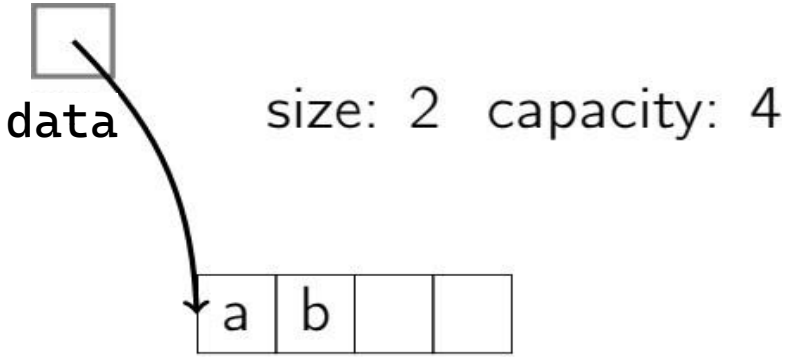

```
// 1. Allocate new memory based on the new size
```




```
// 2. Copy old array elements into new one
```




```
// 3. Free old Memory, then Update pointer to the new array
```



How to resize array

```
// Helper function to resize the array
void resize(size_t newCapacity) {
    int* newData = new int[newCapacity]; // Allocate new memory
    for (size_t i = 0; i < size; ++i) {
        newData[i] = data[i]; // Copy existing data
    }
    delete[] data; // Free old memory
    data = newData; // Point to new memory
    capacity = newCapacity; // Update capacity
}
```

✓ Insert an element at specific location

```
// Insert element at specific index
void insert(size_t index, int element) {
    if (index > size) {
        throw std::out_of_range("Index out of range");
    }
    if (size >= capacity) {
        resize(capacity * 2); // Double the capacity
    }
    for (size_t i = size; i > index; --i) {
        data[i] = data[i - 1]; // Shift elements to the right
    }
    data[index] = element; // Insert new element
    ++size; // Increment size
}
```

✓ Delete an element from specific location

```
// Remove element at index
void remove(size_t index) {
    if (index >= size) {
        throw std::out_of_range("Index out of range");
    }
    for (size_t i = index; i < size - 1; ++i) {
        data[i] = data[i + 1]; // Shift elements to the left
    }
    --size; // Decrease size

    // Optionally shrink the array
    if (size <= capacity / 4) {
        resize(capacity / 2); // Halve the capacity
    }
}
```

✓ Find an element at a specific location

```
// Find element
int find(int element) const {
    for (size_t i = 0; i < size; ++i) {
        if (data[i] == element) {
            return i; // Return index of the found element
        }
    }
    return -1; // Return -1 if not found
}
```

✓ get an element at a specific location

```
// Access element at index
int get(size_t index) const {
    if (index >= size) {
        throw std::out_of_range("Index out of range");
    }
    return data[index];
}
```

✓ Clear array elements

```
// Clear the array
void clear() {
    size = 0; // Reset size to 0
    // Optionally resize to initial capacity
    resize(2);
}
```

✓ get current size of array

```
// Get current size
size_t getSize() const {
    return size;
}
```

✓ Display array elements

```
// Display array elements
void display() const {
    for (size_t i = 0; i < size; ++i) {
        std::cout << data[i] << " ";
    }
    std::cout << std::endl;
}
```

```cpp
int main() {
    DArray arr; // Create a dynamic array

    arr.add(10);
    arr.add(20);
    arr.add(30);
    arr.display(); // Output: 10 20 30

    arr.insert(1, 15); // Insert 15 at index 1
    arr.display(); // Output: 10 15 20 30
    // Output: Index of 20: 2
    std::cout << "Index of 20: " << arr.find(20) << std::endl;
    // Output: Index of 40: -1
    std::cout << "Index of 40: " << arr.find(40) << std::endl;

    arr.remove(2); // Remove element at index 2
    arr.display(); // Output: 10 15 30
    arr.clear(); // Clear the array
    arr.display(); // Output: (empty line)

    return 0;
```

Test Darray data structure in main function

```cpp
#include<iostream>
#include<stdexcept>
#include"DADS.h"
int main() {
DArray<int> arrobj; // cap=2
arrobj.append(5);
arrobj.append(2);
arrobj.append(74);  //Resize cap=4
arrobj.append(30);
arrobj.append(3);  //Resize cap=8
arrobj.displaydata();
arrobj.Insert(7, 2);
arrobj.displaydata();
arrobj.Remove();
arrobj.displaydata();
arrobj.Delete(2);
arrobj.displaydata();
std::cout << "Founded in index=" << arrobj.linearsearch(30) << std::endl;
arrobj.bubblesort();
arrobj.displaydata();
size_t index = arrobj.Binarysearch(30);
index == -1 ? std::cout << "Not founded!!" : std::cout << "founded in index " << index
arrobj.reversearr();
return 0;
```

Test Darray – Output

Microsoft Visual Studio Debug Console

```
5 2 74 30 3
5 2 7 74 30 3
5 2 7 74 30
5 2 74 30
Founded in index=3
2 5 30 74
founded in index 2
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Press any key to continue . . .
```

Aspect	Stack-Based Array	Heap-Allocated Array
Memory Location	The array resides on the stack, used for function call management and local variables.	The array resides on the heap, allowing dynamic memory allocation.
Memory Management	Memory is automatically allocated and deallocated based on the function's scope.	Explicit allocation and deallocation required using functions like `new`.
Scope	Limited to the function's scope.	Extends beyond the allocation scope, making it accessible from other parts of the program.
Size	Requires a known size at compile-time.	Size can be determined at runtime, providing flexibility.
Access Speed	Generally faster due to stack nature.	Slightly slower due to dynamic allocation.

Some Hints for best practice

Dr. Mahmoud Alnamoly

Hint #1:
Resource Acquisition Is Initialization

- ✓ RAII (Resource Acquisition Is Initialization) is a design principle in C++ where resources like dynamic memory are acquired and released automatically through constructors and destructors.

- ✓ Ensure that the constructor allocates the dynamic array and the destructor deallocates it.

Hint #2:
Rule of Three

In C++, if a class manages a resource like dynamic memory, you need to properly implement the Rule of Three:-

- ✓ **Destructor:** To free the memory.
- ✓ **Copy Constructor:** To correctly copy the array when copying objects.
- ✓ **Copy Assignment Operator:** To correctly handle assignments between objects.

```
class DynamicArray {
private:
    int* arr;
    int size;

public:
    // Constructor
    DynamicArray(int size) : size(size) {
        arr = new int[size];
    }

    // Destructor
    ~DynamicArray() {
        delete[] arr;
    }

    // Copy Constructor (Deep copy)
    DynamicArray(const DynamicArray& other) {
        size = other.size;
        arr = new int[size];
        for (int i = 0; i < size; ++i) {
            arr[i] = other.arr[i];
        }
    }
```

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```
    // Copy Assignment Operator (Deep copy)
    DynamicArray& operator=(const DynamicArray& other) {
        if (this != &other) {  // Self-assignment check
            delete[] arr;       // Clean up old memory
            size = other.size;
            arr = new int[size];
            for (int i = 0; i < size; ++i) {
                arr[i] = other.arr[i];
            }
        }
        return *this;
    }
};
```

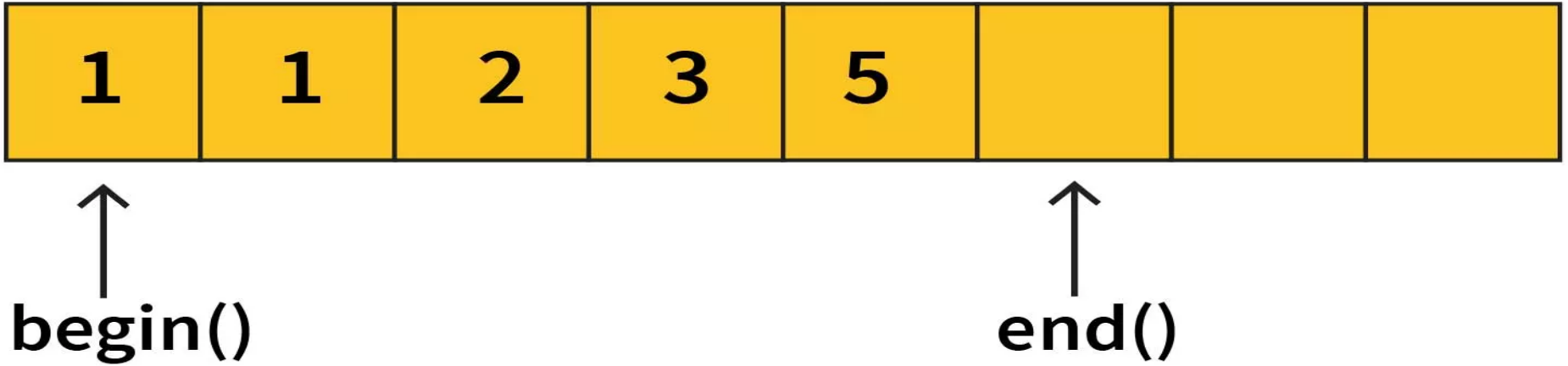
Hint #3:
Resizing Operation

✓ The resizing operation is triggered by the following rules:-

- On Add: If the current size of the array equals its capacity, just before inserting a new element.

- On Remove: If the capacity of the array is greater than or equal to three times the current size of the array, right after removing an element.

- Since the size of dynamically allocated arrays isn't known at compile-time, you can't use range-based loops directly. However, you can still use a traditional for loop with auto to simplify the type handling.



For Resize

```
std::copy(arr, arr + size, new_array);
```

For Insertion

```
std::copy_backward(arr + index, arr + size, arr + size + 1);
```

For Delete

```
std::copy(arr + index + 1, arr + size, arr + index);
```

Optimized Copy for Resize

```
#include <algorithm>
```

```
void resize() {
    size_t new_capacity = max(2* size,2);
    T* brr = new T[new_capacity];
    for (int i=0; i< size; i++)
        brr[i] = arr[i];
    delete [] arr;
    arr = brr;
    capacity = new_capacity;
}
```

```
std::copy(arr+0, arr+size, brr+0);
```

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Optimized Copy for Remove

```
#include <algorithm>
```

```
void Remove(int i) {
    assert(i >= 0 && i< size);
    for (int j=i; j<size-1; j++)
      a[j] = a[j + 1];
    size--;
    if (size >= 3 * capacity)    resize();
}
```

```
std::copy(arr+i+1,arr+size,arr+i);
```

Hint #5:
Operator Overloading for Array-Like Access

To make your class behave like a native array, you can overload the operator[].
This allows you to access elements in the same way you access elements in a built-in array.

```
DynArray Obj;
cout << Obj.get(5);
cout << Obj[5];
```

```
int& operator[](int index) {
    if (index >= 0 && index < size) {
        return arr[index];
    }
    throw std::out_of_range("Index out of range");
}
```

Operator Overloading

```
DynArray Obj;
cout << Obj.get(5);
cout << Obj[5];
```

Get(*i*)

```
if i < 0 or i ≥ size:
   ERROR: index out of range
return arr[i]
```

```
T& operator[](int i) {
    assert(i >= 0 && i < size);
    return arr[i];
}
```

Linked List

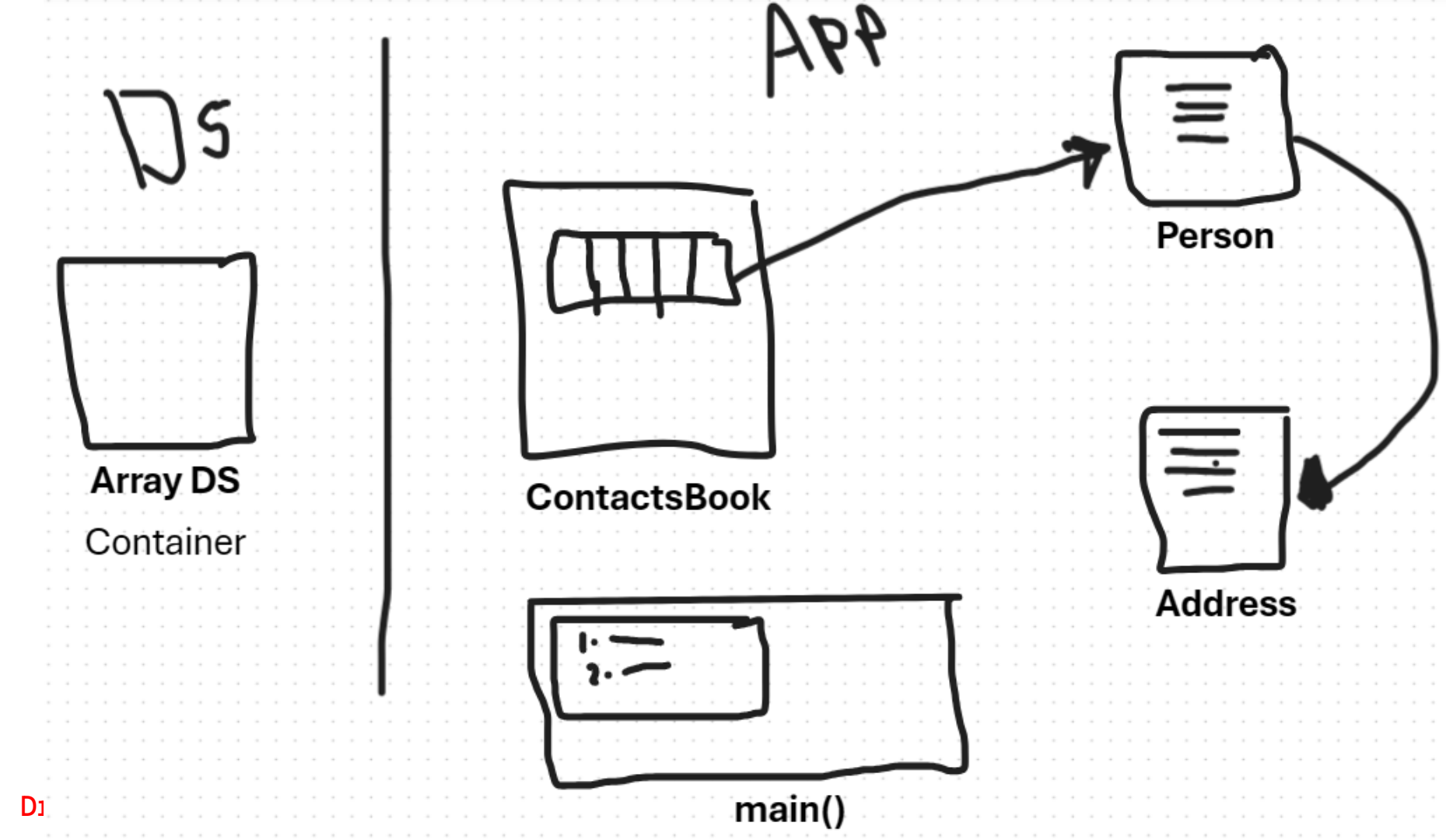
>>> Next Lecture

1st Project

CodeWithArrayDS

Deadline
31/10/2024 at 12:00 Am

Dr. Mahmoud Alnamoly


DS
App
Array DS
Container
ContactsBook
Person
Address
main()

Requirements

1. UML Class Diagram of project (Relationships)

2. Container (Data Structure) as a separated file (.h)

3. Final Program tested without any error

Features that should be in project #1

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```
============================================================
Contacts Book Menu:
-------------------------
1. Add Contact
2. Search by Last Name (Enter LastName correctly)
3. Search by Classification (friend,work,family,other)?
4. Print All Contacts
5. Print Fav Contacts
6. Save to File
7. Load from File
8. Delete Contact
9. Update Contact Information
10. Share contact with other
11. Reverse contacts book
12. Exit
============================================================
Enter your choice: 1
```

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```
                    --- Add a New contact ---
Fn: Mahmoud
Ln: Alnamoly
Class ( Friend,work,family,other): Family
Set as Fav: (Press 1 (fav) or 0 (Not) ) 1
How many numbers: 2
Phone #1: +201224304947
Phone #2: +201111233365
How many mails: 1
Phone #1: Mahmoudalnamoly2014@gmail.com
        ::Enter Address details::
streetnum:39
streetname:Mahmoud
town:Sheba
state:Zagazig

                ============================================================
                Contacts Book Menu:
                -------------------------
                1. Add Contact
                2. Search by Last Name (Enter LastName correctly)
                3. Search by Classification (friend,work,family,other)?
                4. Print All Contacts
                5. Print Fav Contacts
                6. Save to File
                7. Load from File
                8. Delete Contact
                9. Update Contact Information
                10. Share contact with other
                11. Reverse contacts book
```

Add

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```
 ---- Contacts Infromations ----
                                ==========================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------
1                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
-------------------------------------------------------------------------------------------------------------------------------------------------
2                   Ahmed               Hassan              Friend              0                   2 r e w             2012365,            dd@ff
-------------------------------------------------------------------------------------------------------------------------------------------------
3                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------

                    ==========================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ==========================================================
Enter your choice:
```

Print all contacts

H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
---- Contacts Infromations ----
                                        ============================================================


ID              FName           LName           Classification  Fav             Address         phone num       Mails
------------------------------------------------------------------------------------------------------------------------
1               Mahmoud         Alnamoly        Family          1               39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
------------------------------------------------------------------------------------------------------------------------
2               Ahmed           Hassan          Friend          0               2 r e w         2012365,        dd@ff
------------------------------------------------------------------------------------------------------------------------
3               Moh             Salah           work            1               2 r 4 gg        201236,         h@d
------------------------------------------------------------------------------------------------------------------------

                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice: 5
```

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```
 ---- Contacts Infromations ----
                                  ============================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------
1                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
-------------------------------------------------------------------------------------------------------------------------------------------------
3                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------

                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice:
```

Print fav contacts

H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
 ---- Contacts Infromations ----
                                  ============================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------
1                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
-------------------------------------------------------------------------------------------------------------------------------------------------
2                   Ahmed               Hassan              Friend              0                   2 r e w             2012365,            dd@ff
-------------------------------------------------------------------------------------------------------------------------------------------------
3                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------

                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice: 9
```

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```
Fn: Mahmoud
Ln: HassanMohammed
Class ( Friend,work,family,other): Work
Set as Fav: (Press 1 (fav) or 0 (Not) ) 1
How many numbers: 1
Phone #1: +201365
How many mails: 1
Phone #1: ff@
        ::Enter Address details::
streetnum:6
streetname:q
town:q
state:q
 ---- Contacts Infromations ----
```

Update Contact Info

```
                                        ========================================================

ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------------
1                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365-
4@gmail.com                                                                                                                                           ,
-------------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             HassanMohammed      Work                1                   6 q q q             201365,             ff@       -
-------------------------------------------------------------------------------------------------------------------------------------------------------
3                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------------

                    ========================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
```

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```
state:q
 ---- Contacts Infromations ----
                                   ============================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------
1                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365
4@gmail.com
-------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             HassanMohammed      Work                1                   6 q q q             201365,             ff@
-------------------------------------------------------------------------------------------------------------------------------------------------
3                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------

                    ============================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice: 11
```

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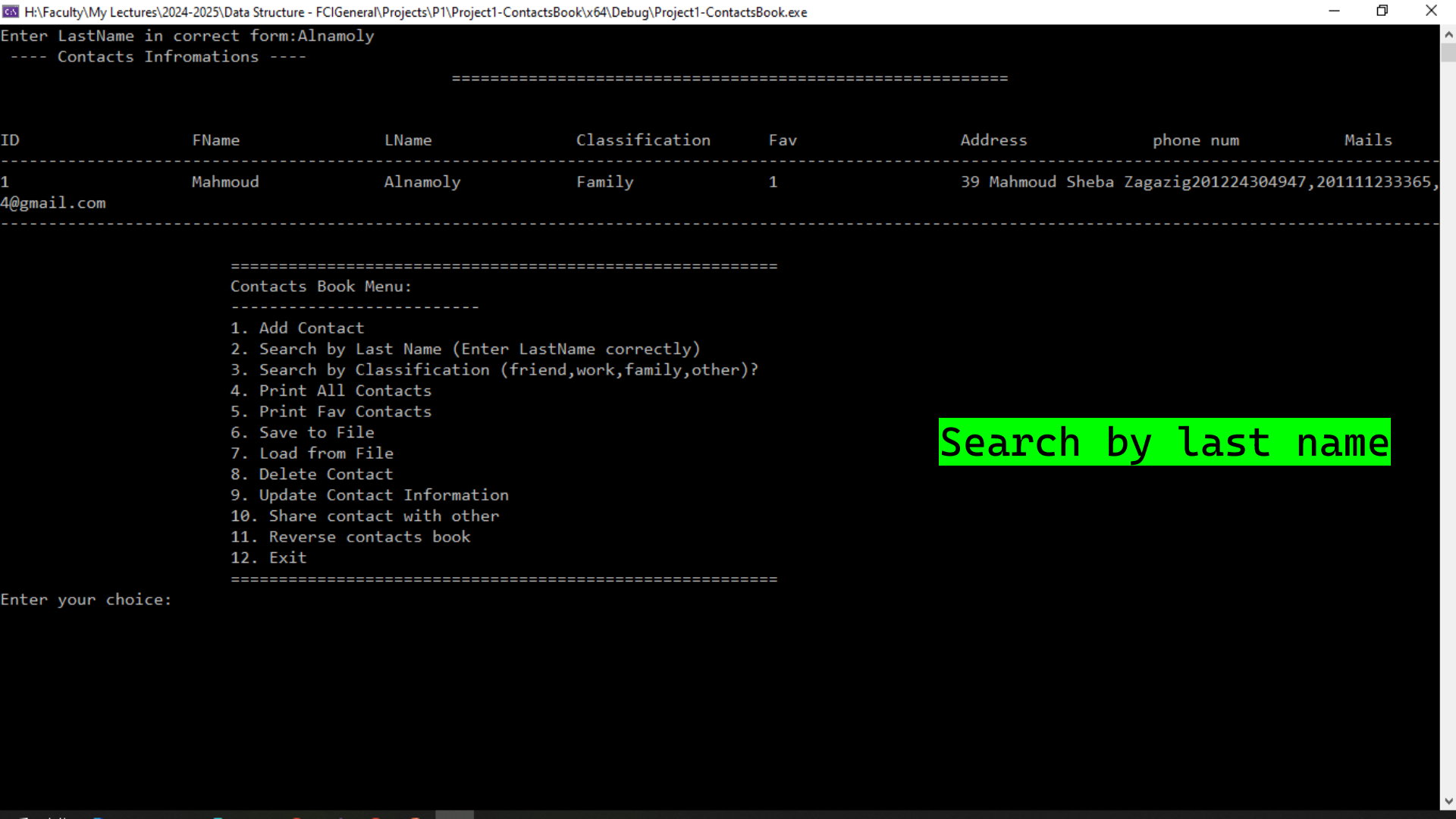
```
 ---- Contacts Infromations ----
                                ==========================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
------------------------------------------------------------------------------------------------------------------------------------------------------
1                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
------------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             HassanMohammed      Work                1                   6 q q q             201365,             ff@
------------------------------------------------------------------------------------------------------------------------------------------------------
3                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
------------------------------------------------------------------------------------------------------------------------------------------------------

                    ==========================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ==========================================================
Enter your choice:
```

Reverse

H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
---- Contacts Infromations ----
                                        ========================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
-------------------------------------------------------------------------------------------------------------------------------------------------------
1                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
-------------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             HassanMohammed      Work                1                   6 q q q             201365,             ff@
-------------------------------------------------------------------------------------------------------------------------------------------------------
3                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
-------------------------------------------------------------------------------------------------------------------------------------------------------

                    ========================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ========================================================
Enter your choice: 2
```


H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe
Enter LastName in correct form:Alnamoly
---- Contacts Infromations ----
ID FName LName Classification Fav Address phone num Mails
1 Mahmoud Alnamoly Family 1 39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
Contacts Book Menu:
1. Add Contact
2. Search by Last Name (Enter LastName correctly)
3. Search by Classification (friend,work,family,other)?
4. Print All Contacts
5. Print Fav Contacts
6. Save to File
7. Load from File
8. Delete Contact
9. Update Contact Information
10. Share contact with other
11. Reverse contacts book
12. Exit
Enter your choice:
Search by last name

H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
Enter index of contact: 1
 ---- Contacts Infromations ----
                                   ============================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
------------------------------------------------------------------------------------------------------------------------------------------------------
1                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
------------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
------------------------------------------------------------------------------------------------------------
```

```
                    ============================================================
                    Contacts Book Menu:
                    -------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice:
```

Delete a contact

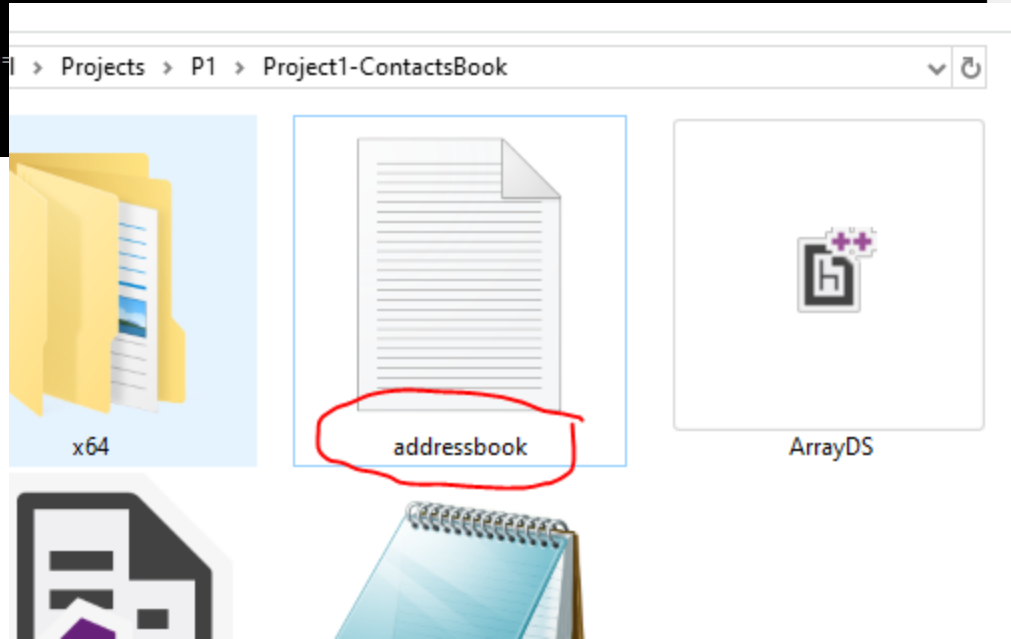
H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
Enter class in correct form (friend,work,family,other):work
 ---- Contacts Infromations ----
                                        ============================================================


ID              FName           LName           Classification  Fav             Address         phone num       Mails
-------------------------------------------------------------------------------------------------------------------------
1               Moh             Salah           work            1               2 r 4 gg        201236,         h@d
-------------------------------------------------------------------------------------------------------------------------


                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice: 6
```

H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe

```
Data saved to file.

                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice:
```

Save to file



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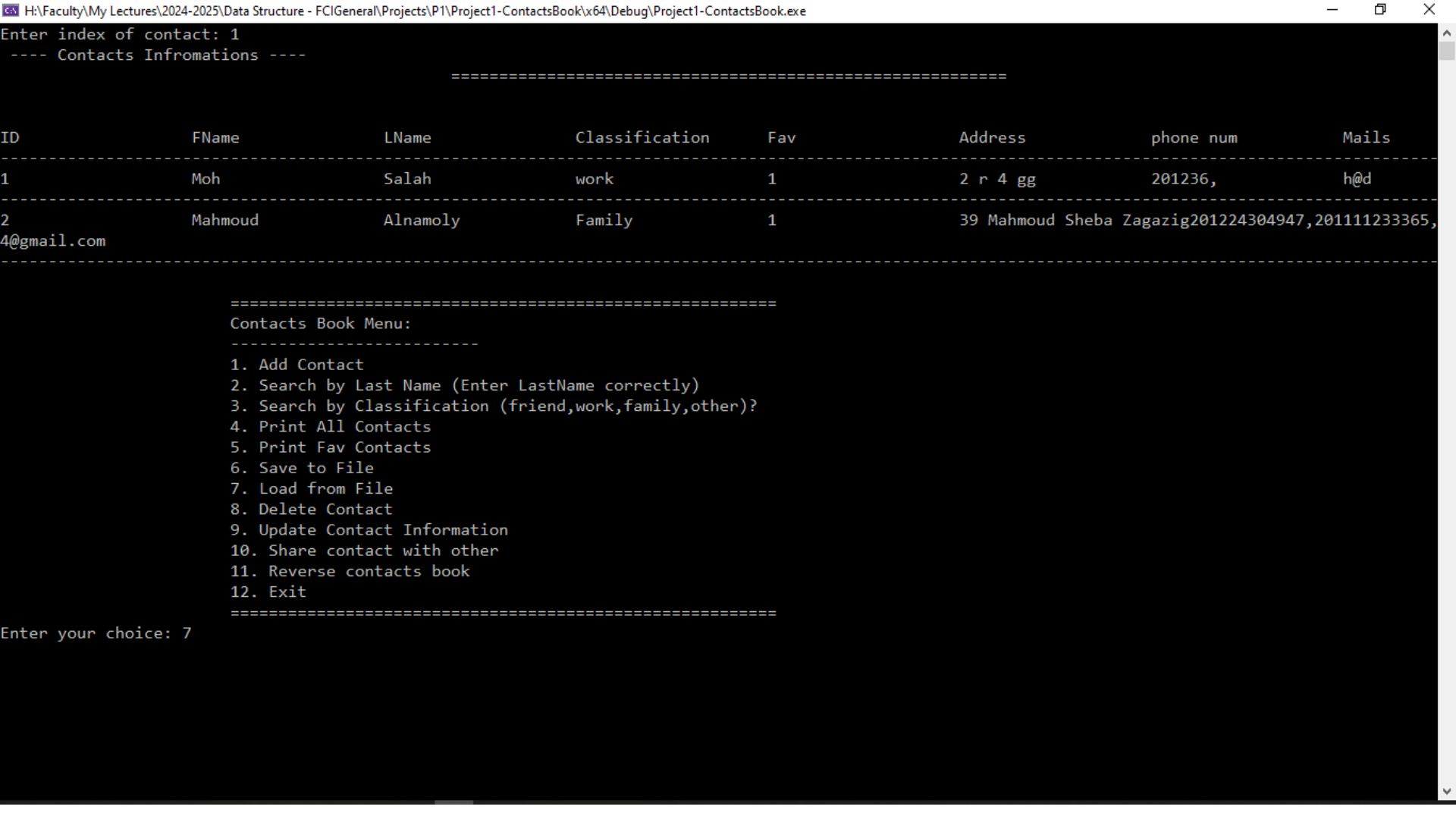
H:\Faculty\My Lectures\2024-2025\Data Structure - FCIGeneral\Projects\P1\Project1-ContactsBook\x64\Debug\Project1-ContactsBook.exe
Enter index of contact: 1
---- Contacts Infromations ----
ID FName LName Classification Fav Address phone num Mails
1 Moh Salah work 1 2 r 4 gg 201236, h@d
2 Mahmoud Alnamoly Family 1 39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
Contacts Book Menu:
1. Add Contact
2. Search by Last Name (Enter LastName correctly)
3. Search by Classification (friend,work,family,other)?
4. Print All Contacts
5. Print Fav Contacts
6. Save to File
7. Load from File
8. Delete Contact
9. Update Contact Information
10. Share contact with other
11. Reverse contacts book
12. Exit
Enter your choice: 7

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```
 ---- Contacts Infromations ----
                                ============================================================


ID                  FName               LName               Classification      Fav                 Address             phone num           Mails
------------------------------------------------------------------------------------------------------------------------------------------------------
1                   Moh                 Salah               work                1                   2 r 4 gg            201236,             h@d
------------------------------------------------------------------------------------------------------------------------------------------------------
2                   Mahmoud             Alnamoly            Family              1                   39 Mahmoud Sheba Zagazig201224304947,201111233365,
4@gmail.com
------------------------------------------------------------------------------------------------------------------------------------------------------

                    ============================================================
                    Contacts Book Menu:
                    --------------------------
                    1. Add Contact
                    2. Search by Last Name (Enter LastName correctly)
                    3. Search by Classification (friend,work,family,other)?
                    4. Print All Contacts
                    5. Print Fav Contacts
                    6. Save to File
                    7. Load from File
                    8. Delete Contact
                    9. Update Contact Information
                    10. Share contact with other
                    11. Reverse contacts book
                    12. Exit
                    ============================================================
Enter your choice:
```

Load data from file

Attendance of Lec3 =>

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